AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. **(Currently Amended)** A temperature control system for a thermal reactor having a process chamber, the control system comprising:

    a first control loop comprising a conventional controller and using a spike temperature sensor signal as input for the conventional controller, which provides an output signal that controls power to a heating element of a thermal reactor, the spike temperature sensor located in proximity to the heating element and spaced from the process chamber; and

    a second control loop comprising a Model-Based Predictive Controller (MBPC), using a paddle temperature sensor signal as input for the MBPC, which provides as an output a spike temperature control setpoint that is used as input for the conventional controller in the first control loop, the paddle temperature sensor spaced from the heating element and located inside or in proximity to the process chamber, wherein the MBPC is provided with a predictive model representing the behavior of the thermal reactor, the MBPC being configured to calculate an output value based on calculations over a predictive time horizon, using the predictive model.

2. **(Original)** The temperature control system of Claim 1, wherein the conventional controller comprises an H ∞ controller.

3. **(Original)** The temperature control system of Claim 1, wherein the conventional controller comprises a PID controller.

4. **(Original)** The temperature control system of Claim 3, wherein the conventional controller comprises a PID controller, said temperature control system further comprising a PID auto-tuning mechanism that adjusts one or more PID parameters as a function of temperature control setpoint and a ramp rate of said temperature control setpoint.

5.   (Original) The temperature control system of Claim 1, further comprising a model identification and data acquisition module that applies closed-loop control using said conventional controller during the execution of a model identification recipe that performs a ramp-up of the thermal reactor to one or more stabilization temperatures.

6.   (Currently Amended) The temperature control system of Claim 1, wherein the MBPC ~~controller~~ is provided with one or more linear dynamic models that characterize thermal response of the thermal reactor.

7.   (Original) The temperature control system of Claim 6, wherein said linear dynamic models characterize said thermal response over one or more temperature sub-ranges.

8.   (Original) The temperature control system of Claim 7, wherein fuzzy control logic is applied to bring about a relatively smooth transition from a first linear dynamic model, operative in a first temperature sub-range, to a second linear dynamic model, operative in a second temperature sub-range.

9.   (Original) The temperature control system of Claim 1, wherein the MBPC comprises a trajectory planner which automatically reduces a specified ramp rate when approaching a constant temperature control setpoint.

10.   (Currently Amended) The temperature control system of Claim 1, wherein the output of the MBPC ~~controller~~ is limited by a static model, said static model describing a relationship between spike temperature and paddle temperature under relatively steady-state conditions.

11.   (Currently Amended) The temperature control system of claim 10, wherein the static model is a fourth order model.

12.   (Original) The temperature control system of Claim 1, wherein a signal from a failed temperature sensor is replaced by a soft-sensor signal computed by a soft-sensor module from at least data obtained from a functioning temperature sensor.

13.   (Original) The temperature control system of Claim 12, wherein said soft-sensor module comprises a dynamic model.

14.   (**Currently Amended**) A control system comprising:

a first control loop comprising a conventional controller for controlling a plant, said conventional controller configured to receive sensor data from at least one first sensor configured to sense one or more operating parameters of said plant; and

a second control loop comprising a Model-Based Predictive Controller (MBPC), said ~~Model-Based Predictive Controller~~ MBPC configured to provide a control setpoint to said conventional controller, said control setpoint based at least in part on calculations over a predictive time horizon, said ~~Model-Based Predictive Controller~~ MBPC further configured to receive sensor data from at least one second sensor that senses one or more operating parameters of said plant.

15.   (**Original**) The control system of Claim 14 wherein said conventional controller comprises an H ∞ controller.

16.   (**Original**) The control system of Claim 14 wherein said conventional controller comprises a PID controller.

17.   (**Original**) The control system of Claim 14 wherein said conventional controller comprises a linear controller.

18.   (**Original**) The control system of Claim 14 wherein said conventional controller comprises a PID controller, said control system further comprising a PID auto-tuning mechanism configured to adjust control parameters of said PID controller as a function of said control setpoint.

19.   (**Currently Amended**) The control system of Claim 14 wherein said MBPC ~~controller~~ is provided with one or more linear dynamic models that characterize a desired plant to be controlled.

20.   (**Original**) The control system of Claim 19 wherein at least one of said one or more linear dynamic models corresponds to a control setpoint sub-range.

21.   (**Original**) The control system of Claim 14 further comprising fuzzy control logic to bring about a relatively smooth transition from a first linear dynamic model, operative in a first control setpoint sub-range, to a second linear dynamic model, operative in a second control setpoint sub-range.

22.   (Original) The control system of Claim 14 wherein said MBPC comprises a trajectory planner to control a time rate of change of said control setpoint.

23.   (Currently Amended) The control system of Claim 14 wherein an output of said MBPC ~~controller~~ is limited by a static model configured to describe a relationship between said first sensor and said second sensor under steady-state conditions.

24.   (Original) The control system of claim 23 wherein the static model comprises at least a second-order model.

25.   (Original) The control system of Claim 14, further comprising a soft sensor model to approximate an output of said first sensor from at least data produced by said second sensor.

26.   (Original) The control system of Claim 14, further comprising a soft sensor model to approximate an output of said second sensor from at least data produced by said first sensor.

27.   (Original) The control system of Claim 14, wherein said first sensor comprises a spike temperature sensor in a thermal process reactor, and said second sensor comprises a paddle temperature sensor in said thermal process reactor.

28.   (Currently Amended) A method for controlling a plant, comprising:

providing control inputs to said plant from a first controller, said first controller configured to receive sensor data from at least one first sensor configured to sense one or more operating parameters of said plant; and

providing a control setpoint to said first controller, said control setpoint computed by a Model-Based Predictive Controller configured to receive sensor data from at least one second sensor that senses one or more operating parameters of said plant, said Model-Based Predictive Controller further configured to receive a control process sequence for said plant, and said Model-Based Predictive Controller configured to calculate said control setpoint based at least in part on calculations over a predictive time horizon.

29.   (Original) The method of Claim 28 wherein said first controller comprises an H ∞ controller.

30.   (Original) The method of Claim 28 wherein said first controller comprises a PID controller.

31.   (Original) The method of Claim 28 wherein said first controller comprises a linear controller.

32.   (Original) The method of Claim 28 wherein said first controller comprises a PID controller, the method further comprising: adjust control parameters of said PID controller as a function of said control setpoint.

33.   (Original) The method of Claim 28 further comprising calculating one or more linear dynamic models that characterize said plant and providing said one or more linear dynamic models to said Model-Based Predictive Controller.

34.   (Original) The method of Claim 28, further comprising: selecting a plurality of control setpoint sub-ranges, each sub-range corresponding to at least one linear dynamic model.

35.   (Original) The method of Claim 28, further comprising: using fuzzy logic to transition from a first linear dynamic model to a second linear dynamic model.

36.   (Currently Amended) The method of Claim 28, further comprising: trajectory planning in said [[MBPC]] <u>Model-Based Predictive Controller</u> to control a rate of change of said control setpoint.

37.   (Currently Amended) The method of Claim 28, further comprising: limiting an output of said [[MBPC]] <u>Model-Based Predictive Controller</u> according to a static model configured to describe a relationship between said first sensor and said second sensor under relatively steady-state conditions.

38.   (Original) The method of Claim 28, further comprising:

      detecting a failure of said first sensor; and

      using a soft-sensor model to replace said first sensor, said soft sensor model calculating an estimate of said first sensor using at least data produced by said second sensor.

39.   (Original) The method of Claim 28, further comprising:

      detecting a failure of said second sensor; and

      using a soft-sensor model to replace said second sensor, said soft sensor model calculating an estimate of said second sensor using at least data produced by said first sensor.

40.   (**Original**) The method of Claim 28, wherein said control setpoint corresponds to a temperature control setpoint for a thermal process reactor.

41.   (**Original**) The method of Claim 40, wherein said first sensor corresponds to a temperature sensor.

42.   (**Currently Amended**) A system for controlling a plant, having a thermal process chamber, the system comprising:

a first control loop comprising a conventional controller and a first sensor signal as input for the conventional controller, which provides an output signal to control an actuator outside the process chamber to adjust an operating parameter within the process chamber, the first sensor configured to measure the operating parameter, the first sensor located in proximity to the actuator and spaced from the process chamber;

a second control loop comprising a Model-Based Predictive Controller (MBPC), using a second sensor signal as input for the MBPC, which provides an output signal that is used as input for the conventional controller in the first loop, the second sensor configured to measure the operating parameter, the second sensor spaced from said actuator and located inside or in proximity to the process chamber, the MBPC configured to calculate the output signal based at least in part on calculations over a predictive time horizon using a predictive model.

43   (**Original**) The system of claim 42 wherein the process chamber is a thermal process chamber, the first and second sensors are temperature sensors, the actuator is a heat source and controlling the plant comprises controlling the temperature of the thermal process chamber.

44.   (**Currently Amended**) A system for controlling a thermal process plant, comprising:

means for closed-loop feedback control of the plant according to a control setpoint using spike thermocouple sensor feedback; and

a Model-Based Predictive Controller configured to compute said control setpoint from at least sensor data from at least one paddle thermocouple sensor and a control process sequence, said control setpoint based at least in part on calculations over a predictive time horizon.